

U.S. Department of Energy Environmental Activities Related to Coal Bed Methane Produced Water

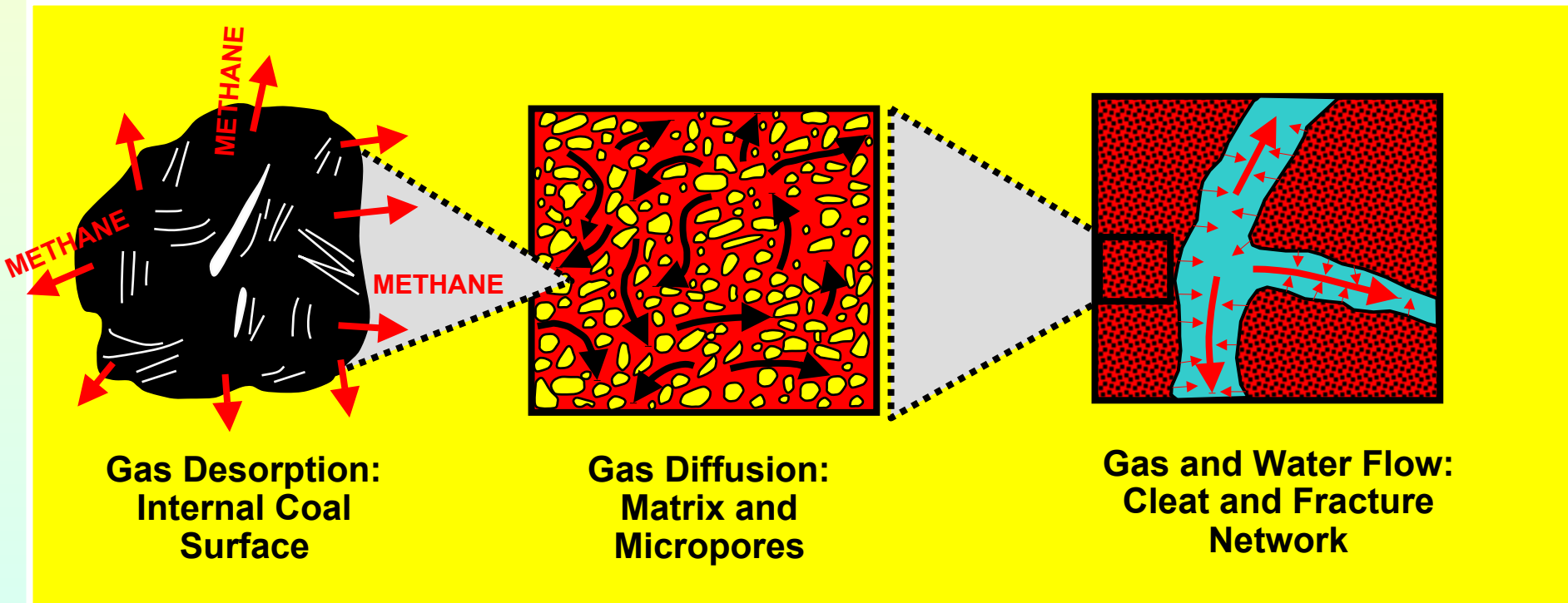


**Presented to:
U.S. – Russia Energy Working Group**

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Office of Fossil Energy**

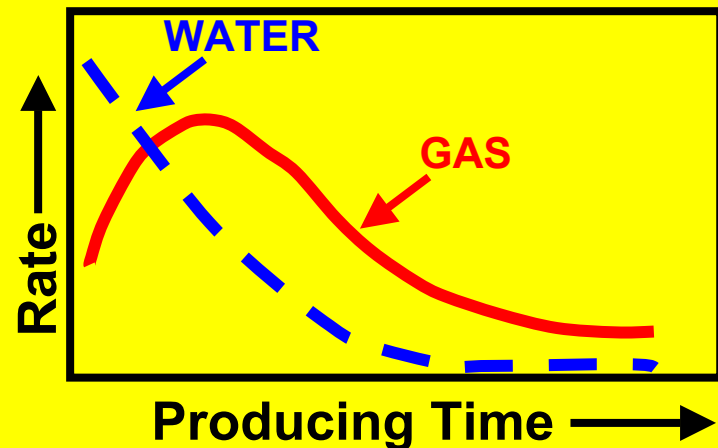
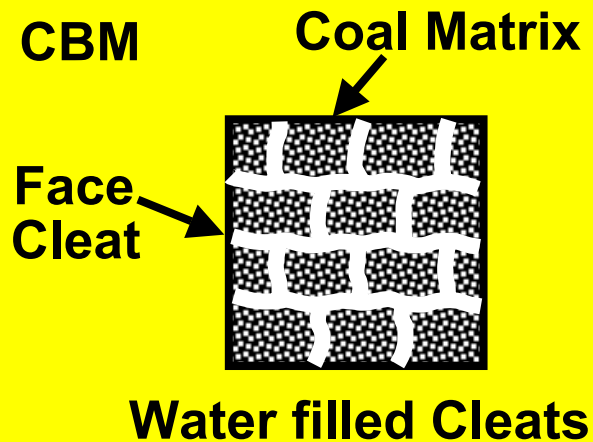
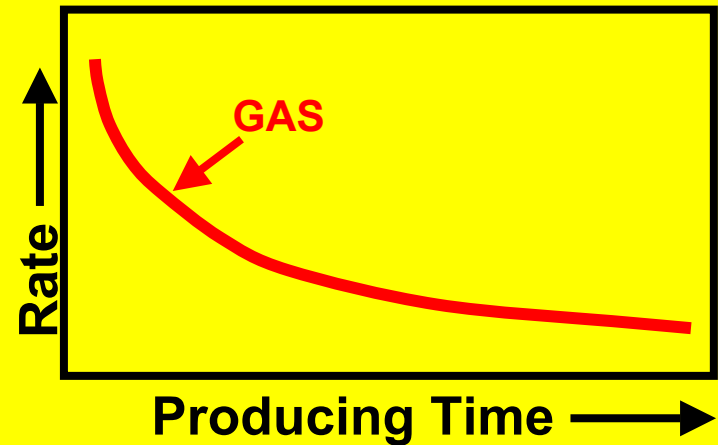
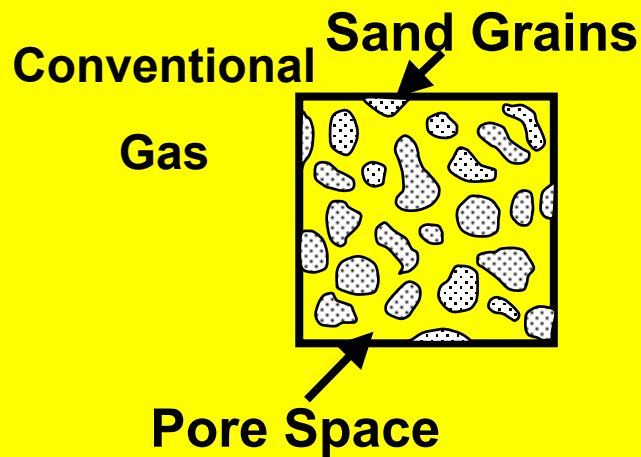
April 8, 2003

Methane Migration

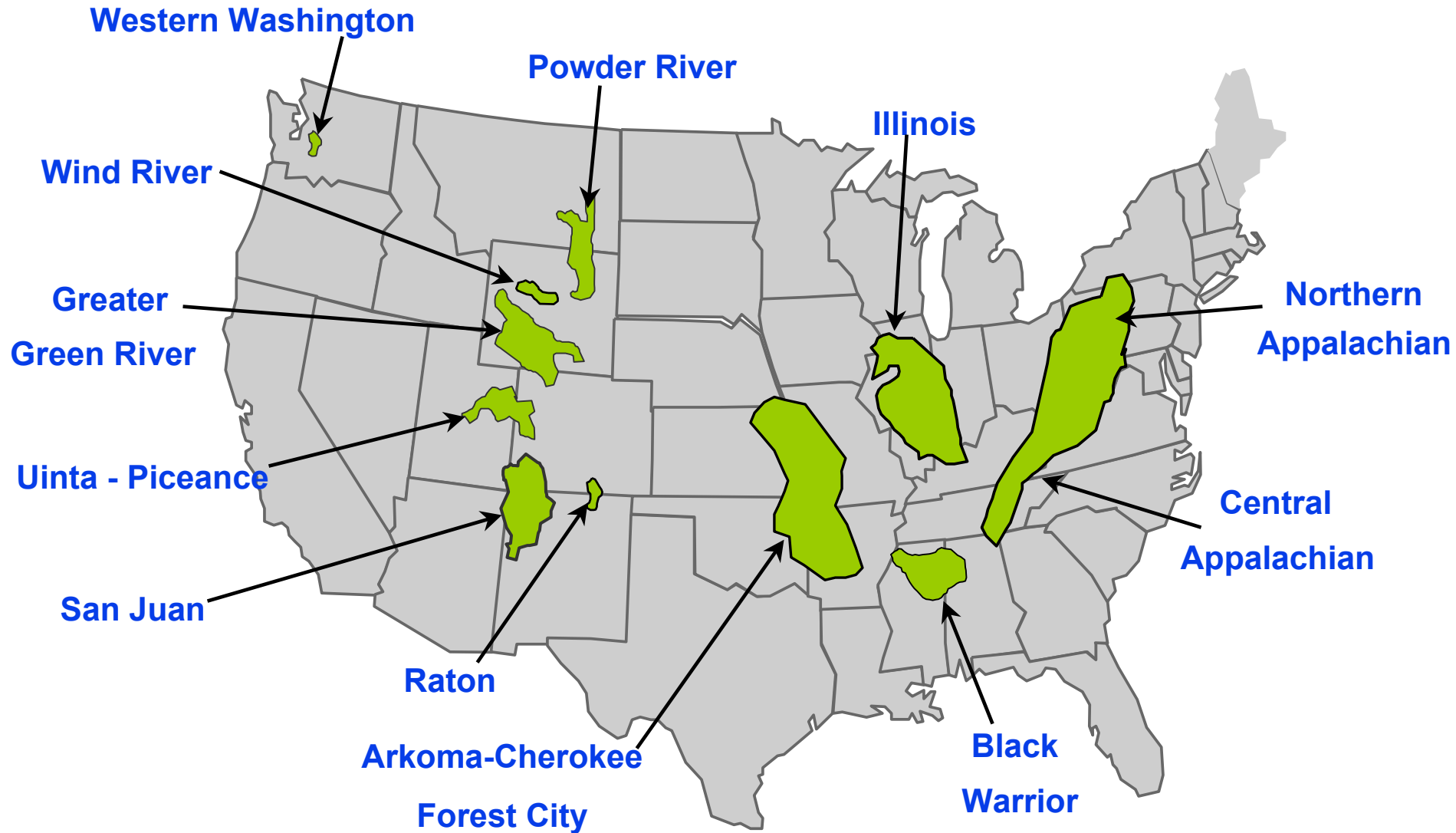


Increasing Size

Conventional Versus CBM Well Behavior



Major Coalbed Methane Basins

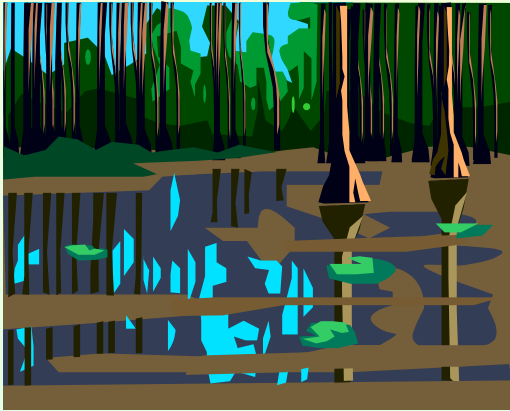


DOE Efforts Related to CBM are Mostly Environmentally Oriented

- ❖ **Phytoremediation**
- ❖ **Best management practices**
- ❖ **Environmental planning tools**
- ❖ **CBM Primer**
- ❖ **Geologic, engineering, economic analysis**
- ❖ **Beneficial use of produced water**



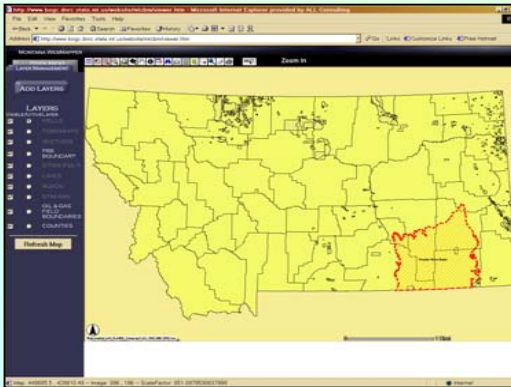
CBM Produced Water Treatment Montana State University



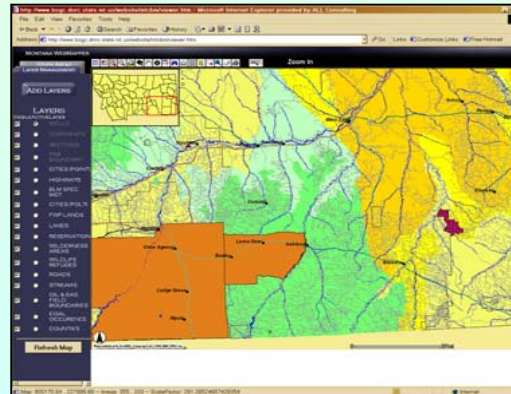
- ❖ **Phytoremediation using constructed wetlands**
- ❖ **Accelerated greenhouse studies**
- ❖ **Volume reduction**
- ❖ **SAR reduction through plants, biofilters, chemical reactions**
- ❖ **Laboratory investigations of water-soil compatibility for irrigation**
- ❖ **Hydrologic assessment**

Developing Mitigation Techniques and Best Management Practices...

- ❖ Provides Internet-based GIS analysis for environmentally sound CBM development
- ❖ Identified potential BMPs and mitigation strategies
- ❖ Developed Best Management Practices Handbook
- ❖ Web-based GIS application built and running:
 - Tool to analyze alternatives for mitigation
 - Mitigation practices can be referenced in handbook
- ❖ Technical workshops



The WebMapper application was developed as a custom ArcIMS application using the Spatial Data Engine (SDE). WebMapper is updated on a real-time basis directly to the MBOGC's SQL Server database which contains current data maintained by the board through its Risk Based Data Management System (RBDMS).



Screen snapshot from “Live” On-Line GIS application – Powder River Basin (Montana)



CBM Well Drilling (Wyoming)



Sound Reduction Barrier (Colorado)

Handbook for Preparation and Review of CBM Environmental Plans

- ❖ Preparation and review of environmental plans can delay development
- ❖ Need for a consistent approach in addressing CBM issues
- ❖ Handbook for use by industry and government
- ❖ Covers: land, air, water, agriculture, cultural, paleontological issues
- ❖ Includes:
 - Project Plans
 - Water Management Plans
 - Environmental Assessments
 - Drilling Permits
 - Archeological Studies



Coal Outcrop – Powder River Basin (MT)

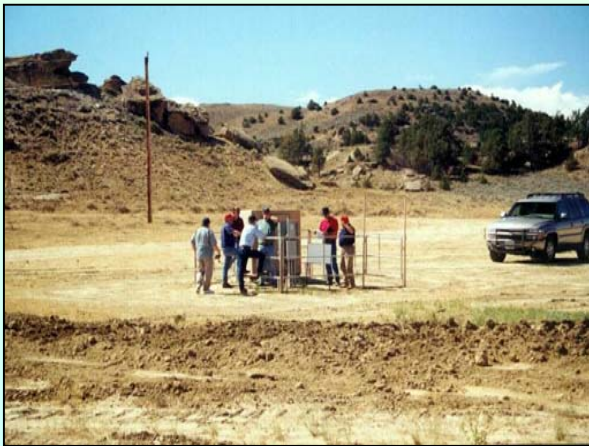


Anti-CBM Protest – Bozeman, MT



CBM Primer

- ❖ **Broad spectrum of stakeholders in CBM development**
- ❖ **Need for understanding on CBM operations**
- ❖ **Summary document to encapsulate information on:**
 - **Coal and CBM resource**
 - **Methane as a form of natural gas**
 - **Split mineral estate**
 - **Development technologies**
 - **Operational issues**
 - **Regulatory framework**
 - **Mitigation and management practices**
 - **Indian Trust issues**
 - **Environmental technologies**



CBM Well House & Pad (Wyoming)



Sub-Bituminous Coal (Montana)



Compressors (Utah)

Powder River Basin CBM Development and Produced Water Management Study

- ❖ **Review work products from EPA Study**
(methodology, data, assumptions)
- ❖ **DOE is using our tools and expertise to examine, for the PRB:**
 - The underlying CBM resource
 - Logical basin partitions
 - Future gas and water production volumes
 - Economics of gas production and water disposal options
- ❖ **Study released December 2002**

Overview of Economic Analysis

The costs and economic feasibility of further developing coalbed methane in the powder river basin will be significantly impacted by produced water management practices and requirements.

Economically Recoverable CBM (Tcf)

Economic Conditions	Alternative Water Disposal Options			
	Surface Discharge	Impoundment	Shallow Reinjection	Active Treatment
Case 1 (Today)*	1.5	--	--	--
Case 2 (Transition)**	22.4	20.0	18.8	7.1-10.2
Case 3 (Long Term)***	29.1	27.8	27.1	17.8-21.6

* Basin differential remains at \$1.80 per Mcf.

** Basin differential narrows from \$1.80 per Mcf in year 1 to \$0.80 per Mcf in year 3 and beyond.

*** Basin differential is \$0.80 per Mcf.



Partnerships

- ❖ **Federal Lands Technology Partnership with BLM**
 - **Ground water monitoring**
 - **Soil application of produced water**
 - **Site evaluation/infiltration studies**
- ❖ **Ground Water Protection Research Foundation**
 - **Beneficial Use Study**
 - **Partner with BLM and Forest Service**



Beneficial Use Study

- ❖ **Jointly funded by DOE and BLM**
- ❖ **Investigate the feasibility of CBM water management and beneficial use alternatives:**
 - **Technical**
 - **Conceptual engineering**
 - **Regulatory**
 - **Water rights**
 - **Economics**
- ❖ **Covers basins in the Rocky Mountain Region**
- ❖ **Wide participation from government and industry**
- ❖ **Produce technical handbook on feasible options for beneficial use and water management**

Feasibility Study For Coal Bed Methane Produced Water Management and Beneficial Use Alternatives

Several Water Management and Beneficial Use Alternatives are being analyzed as part of this research effort. Furthermore, data from several other studies, including DOE research, is being utilized in this research.



Tongue River Discharge (MT)



CBM PW Fish Pond (WY)



UV Ionization of CBM PW (WY)



CBM PW Irrigation (WY)

Water Management and Beneficial Use Alternatives

Underground Injection

- ❖ Disposal via Class II injection wells
- ❖ Aquifer Storage/Recovery (Class V well)
- ❖ Aquifer Recharge (Class V well)

Agricultural Use

- ❖ Cattle Watering
- ❖ Irrigation
- ❖ Soil Remediation

Impoundments

- ❖ Wildlife watering
- ❖ Fisheries
- ❖ Recharge ponds
- ❖ Recreation
- ❖ Evaporation ponds
- ❖ Constructed wetlands

Surface Discharge

- ❖ Land Surface Discharge
- ❖ Direct Surface Water Discharge
- ❖ Non-Point Source Discharge

Industrial Use

- ❖ Dust Control
- ❖ Oil & Gas Drilling Fluids
- ❖ Coal Mines
- ❖ Power Generation
- ❖ Field Washing
- ❖ Other Miscellaneous

Public/Domestic Use

- ❖ Domestic
- ❖ Municipal